

Measure Information Template (JH-9)

Category: Nonresidential – mechanical.

Description: Require electronically-commutated motors for fan motors less than 1 hp in series terminal units per Seattle Energy Code Section 1537.

(1) Title 24, Part 6, Section 144. Prescriptive Requirements for Space Conditioning Systems:

Require electronically-commutated motors for fan motors less than 1 hp in series terminal units.
These fans run constantly and consequently should be energy efficient.

Code Language Proposal:

- Title 24, Part 6, Section 144. Prescriptive Requirements for Space Conditioning Systems (pages 97-98).

Title 24, Part 6, SECTION 144

– PRESCRIPTIVE REQUIREMENTS FOR SPACE CONDITIONING SYSTEMS

(revisions to subsection c only in this proposal, other subsections to remain unchanged)

(c) **Power Consumption of Fans.** Fan motors less than 1 hp in series terminal units shall be electrically-commutated motors. In addition, each fan system used for comfort space conditioning with a total fan power index over 25 horsepower shall meet the requirements of Item 1 or 2 below, as applicable. Total fan system power demand equals the sum of the power demand of all fans in the system that are required to operate at design conditions in order to supply air from the heating or cooling source to the conditioned space, and to return it back to the source or to exhaust it to the outdoors; however, total fan system power demand need not include the additional power demand caused solely by air treatment or filtering systems with final pressure drops more than one-inch water column (only the energy accounted for by the amount of pressure drop that is over one inch may be excluded), or fan system power caused solely by process loads.

1. **Constant volume fan systems.** The total fan power index of each fan system at design conditions shall not exceed 0.8 watts per cfm of supply air.
2. **Variable air volume (VAV) systems.**
 - A. The total fan power index of each fan system at design conditions shall not exceed 1.25 watts per cfm of supply air; and
 - B. Individual VAV fans with motors over 25 horsepower shall meet one of the following:
 - i. The fan motor shall be driven by a mechanical or electrical variable speed drive.
 - ii. The fan shall be a vane-axial fan with variable pitch blades.
 - iii. For prescriptive compliance, the fan motor shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume when static pressure set point equals 1/3 of the total design static pressure, based on certified manufacturer's test data.
3. **Air-treatment or filtering systems.** For systems with air-treatment or filtering systems, calculate the adjusted fan power index using the following equation:

Adjusted fan power index = Fan power index x Fan Adjustment

$$\text{Fan Adjustment} = 1 - (SP_a/SP_f)$$

WHERE:

SP_a = Air pressure drop across the air-treatment or filtering system.

SP_f = Total pressure drop across the fan.

Benefits: In a typical nonresidential building, the fans run continuously to provide ventilation. Fan energy is as large or larger than the heating and cooling energy (based upon modeling and metering). Fan powered mixing boxes are used in most nonresidential buildings in Seattle. They incorporate a small motor that helps circulate the air. This motor is typically only 40-50% efficient (and can be as low as 15-20% efficiency when not operating at peak load) and has a primitive speed control that is also inefficient. Because of the number of boxes in a building, the total fan power in these little motors typically represents one-quarter of the total installed fan power. However, because these small motors run continuously while the central fan modulates on a VFD (variable frequency drive), and because they are very inefficient, they consume half of the energy used for fans in the typical building. Electronically-commutated motors provide significant energy savings.

Environmental Impact: Energy savings.

Type of Change: Prescriptive.

Measure Availability and Cost: Electronically-commutated motors are an option offered by all the major mixing box manufacturers. GE is the most well know manufacturer of the motors, FASCO has an equivalent motor, and Emerson is releasing what they are calling an ECM. As for international suppliers, EBM is believed to have a similar type of motor. Estimate of cost is \$150-\$230/mixing box. At one box per 1,000-2,000 square feet, the cost is roughly \$0.15/square foot of building.

Useful Life, Persistence and Maintenance: Same as current fans.

Performance Verification: Same as current fans.

Cost Effectiveness: Seattle consultant estimate of site energy savings is 510-1,500 kWh per box per year (\$51 to \$150 at \$0.10/kWh). The Carrier Company in their publication "ECM Motors in Series Flow Fan Powered Terminals and Unit Ventilators" provides a savings range of 861-1,215 kWh per box per year (\$86 to \$122 at \$0.10/kWh).

Analysis Tools: NA.

Relationship to Other Measures: NA.

Bibliography and Other Research: The Carrier Company publication "ECM Motors in Series Flow Fan Powered Terminals and Unit Ventilators", and Seattle Energy Code, Section 1437.

Code Section: 144 (e). Economizers (page 40).

Proposal: Require economizers for smaller units per ASHRAE/IESNA Standard 90.1 and Seattle Energy Code Sections 1423/1433.

Discussion: Economizer should be utilized more fully in California's mild climates.